

GS/jo 001363US

August 20, 2001

**PROCESS FOR FORMING TUBE-SHAPED HOLLOW BODIES MADE
OF METAL**

The invention concerns a process for forming tube-shaped hollow bodies made of metal according to the generic portion of patent claim 1.

Forming tube-shaped hollow bodies made out of metal by soft annealing the hollow body, further processing it depending on the requirements of the final shape sought, and finally hydroforming it in a die through a medium introduced into the hollow body is known.

Because the material solidifies during hydroforming as the forming progresses, and therefore resists further shaping or even cracks, in practice, changes of only up to approximately 10 % of the cross-section relative to the initial cross-section are possible during one cycle of hydroforming.

The object of the invention is to allow greater alterations of the cross-section.

This object is achieved in a process according to the generic portion of claim 1 by the features of this claim.

Further developments and advantageous embodiments arise from the sub-claims.

Through the upstream processing phase, the tube-shaped hollow body can already be impressed with a temporary cross-sectional shape which tends towards the final cross-sectional shape. In this way, the maximum forming length is again made available for hydroforming by the subsequent soft annealing. Therefore, during the final hydroforming, a final cross-sectional shape, which is relative to the original cross-sectional form of the tube-shaped hollow body after straight seam welding significantly greater than the maximum values achievable until now, can be achieved.

According to a further development, the processing phases of mechanical partial expansion and/or mechanical partial reduction and subsequent soft annealing can be performed multiple times in sequence. In this way, even greater forming lengths can be achieved.

In addition, the tube-shaped hollow body can also be soft annealed before the upstream processing phase. In this way, hardening due to the shaping process into a closed tube is also eliminated and a high forming reserve for the upstream processing phase is achieved.

The partial expansion and/or reduction of the tube-shaped hollow body can be performed at those locations at which the largest alteration of the cross-section after hydroforming relative to the initial cross-section occurs.

Typical further processing phases, such as mechanical bending and mechanical forming, can be performed between the processing phases of soft annealing and hydroforming.

In the following, the invention will be described with reference to the drawing. This shows a sequence of sequential processing phases schematically.

The starting point is a tube-shaped hollow body 10 made of aluminum with a constant annular cross-sectional area, as is illustrated in a).

This hollow body 10 is now partially expanded by a processing tool, in this case by a conical mandrel 12, which is driven axially into the hollow body 10. For performing expansion only within the tube-shaped hollow body 10, an expandable mandrel can be used which is first inserted, then expanded, and then driven further axially over a limited path.

Subsequently, the expanded hollow body 10', as illustrated in b), is soft annealed at approximately 300 °C.

After possible further processing phases, such as bending and/or mechanical forming, hydroforming is performed in a die 14.

For this purpose, the expanded hollow body 10' according to c) is placed in the die 14, whose internal cavity represents the future external dimensions of the hollow body 10'.

After a medium 16 is poured in and pressure is applied by the stamp 18, forming into the final shape of the hollow body 10" according to d) then occurs.